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DEPARTMENT OF THE ARMY
U.S. ARMY CORPS OF ENGINEERS

CESAJ 35 42 35 (Apr 2006)

JACKSONVILLE DISTRICT LOCAL MASTER GUIDE SPECIFICATION

SECTION 35 42 35

POLYMERIC MARINE MATTRESS 04/06

NOTE: This guide specification covers the requirements for installing polymeric marine mattress.

Comments and suggestions are welcome. Using e-mail for feedback is encouraged. Comments should be directed to:

Engineering Division, Design Branch, Specifications Section.

ALL COMMENTS RECEIVED WILL BE DISSEMINATED TO THE PROPER OFFICE FOR RESPONSE.

PART 1 GENERAL

1.1 SUMMARY

This Section consists for furnishing a Polymeric Marine Mattress (PMM) system with structural geogrid, braid, mechanical connection elements and stone fill, and providing a geogrid composite as specified herein and shown on the contract drawings. The geogrid material for the mattress shall include sufficient quantities to form lifting hoops for the units. Fabricating, filling and placing PMM units in accordance with this Section and in reasonably close conformity with the lines, grades and dimensions shown on the contract drawings or approved by the Contracting Officer. Some prefabrication of the units may be accomplished prior to delivery to the site.

1.2 REFERENCES

NOTE: Issue (date) of references included in project specifications need not be more current than provided by the latest change to this guide specification. During the reference reconciliation process, SPECSINTACT will automatically remove references from this paragraph that have been removed from the text. THEREFORE, IT IS NOT NECESSARY TO EDIT THIS PARAGRAPH; IT IS DONE AUTOMATICALLY.

The publications listed below form a part of this specification to the extent referenced. The publication is referred to in the text by basic designation only.

AMERICAN ASSOCIATION OF STATE HIGHWAY AND TRANSPORTATION OFFICIALS
(AASHTO)

AASHTO (2000 Interim) Standard Specifications for
Highway Bridges

AMERICAN SOCIETY FOR TESTING AND MATERIALS (ASTM)

ASTM D 1388 (1996) Stiffness of Fabrics (Option A)

ASTM D 4355 (1992) Deterioration of Geotextiles from
Exposure to Ultraviolet Light and Water
(Xenon-Arc Type Apparatus)

ASTM D 4759 (1988; R 1996) Standard Practice for
Determining the Specification Conformance
of Geosynthetics

ASTM D 5818 (1995; R 2000) Practice for Obtaining
Samples of Geosynthetics from a Test
Section for Assessment of Installation
Damage

GEOSYNTHETIC RESEARCH INSTITUTE (GRI)

GRI GG1-87 Standard Test Method for Geogrid Rib
Tensile Strength

GRI GG2-87 Standard Test for Geogrid Junction Strength

U.S. ENVIRONMENTAL PROTECTION AGENCY (EPA)

EPA 9090 Compatibility Test for Wastes and Membrane
Liners

1.3 SUBMITTALS

NOTE: Submittals must be limited to those necessary
for adequate quality control. The importance of an
item in the project should be one of the primary
factors in determining if a submittal for the item
should be required.

FILL IN BLANK WITH APPROPRIATE APPROVING OFFICE AND
DELETE BRACKETS. ALSO, DELETE SEMICOLON AND
REFERENCE TO "G" IF TO BE USED FOR "FIO" ONLY. WE
NO LONGER SHOW "FIO".

Government approval is required for submittals with a "G" designation;
submittals not having a "G" designation are for information only. When
used, a designation following the "G" designation identifies the office
that will review the submittal for the Government. The following shall be

submitted in accordance with Section 01 33 00 SUBMITTAL PROCEDURES:

SD-02 Shop Drawings

Shop Drawings; [G| []]

The Contractor shall submit details of the typical sections and connections.

SD-04 Samples

The Contractor shall submit product samples for the following:

Geogrid; [G| [____]]
 Braid; [G| [____]]
 Mechanical Connection Elements; [G| [____]]

SD-07 Certificates

Geogrid; [G| [____]]

The Contractor shall submit geogrid product data sheet and certification from the manufacturer that the geogrid product supplied meets the requirements.

SD-08 Manufacturer's Instructions

Manufacturer's Instructions; [G| [____]]

The Contractor shall submit manufacturer's fabrication instructions, installation instructions, and general recommendations.

SD-09 Manufacturer's Field Reports

Roll Values; [G| [____]]

1.4 DEFINITIONS

1.4.1 Polymeric Marine Mattress

A non-metallic compartmental structure filled densely and tightly with stone prior to installation. Filling is achieved while each unit is positioned on edge prior to installation. Units are comprised of structural geogrid, braid, and mechanical connection elements fabricated to allow placement and provide containment of aggregate fill.

1.4.2 Geogrid

An integrally formed grid structure manufactured of a stress resistance high density polyethylene (HDPE) material with molecular weight and molecular characteristics which impart high resistance to:

- a. Loss of load capacity or structural integrity when the geogrid is subjected to mechanical stress in installation.
- b. Deformation when the geogrid is subjected to applied force in use.
- c. Loss of load capacity or structural integrity when the geogrid is

subjected to long-term environmental stress.

1.4.3 Minimum Average Roll Values

Value based on testing and determined in accordance with [ASTM D 4759](#).

1.4.4 True Tensile Modulus in Use

The ratio of tensile strength to corresponding strain (e.g., 1 percent). The tensile strength is measured via [GRI GG1-87](#) as modified by [AASHTO](#) using a single rib having the greater of 3 junctions or 8 inches and tested at a strain rate of 10 percent per minute based on this gauge length without deforming test materials under load before measuring such resistance or employing "secant" or "offset" tangent methods of measurement so as to overstate tensile properties. Values shown are minimum average roll values.

1.4.5 Junction Strength

Breaking tensile strength of junctions when tested in accordance with [GRI GG2-87](#) as modified by [AASHTO](#) using a single rib having the greater of 3 junctions or 8 inches and tested at a strain rate of 10 percent per minute based on this gauge length. Values shown are minimum average roll values.

1.4.6 Flexural Stiffness (Also Known as Flexural Rigidity)

Resistance to bending force measured via [ASTM D 1388](#). Values shown are minimum average roll values.

1.4.7 Resistance to Installation Damage

Resistance to loss of load capacity or structural integrity when subjected to mechanical stress in installation measured via [ASTM D 5818](#) in a crushed stone classified as a poorly graded gravel with a maximum 2 inch particle size (GP). Values shown are typical values.

1.4.8 Resistance to Long Term Degradation

Resistance to loss of load capacity or structural integrity when subjected to chemically aggressive environments measured via [EPA 9090](#) immersion testing. Values shown are typical values.

1.4.9 Ultraviolet Stability

The ratio of tensile strength after exposure to the tensile strength prior to exposure with exposure per [ASTM D 4355](#) and tensile strengths measured via [GRI GG1-87](#) as specified in subparagraph "True Tensile Modulus in Use" of paragraph DEFINITIONS above.

1.5 QUALITY ASSURANCE

Prior to the installation of the units, the Contractor shall arrange a meeting at the site with the system supplier and, where applicable, the system installer. The Contracting Officer shall be notified at least 3 days in advance of the time of the meeting.

NOTE: Measurement and Payment paragraphs are to be included in Section 01270 MEASUREMENT AND PAYMENT. The payment paragraphs should be edited as

appropriate for the project. The following is typical language for this Section:

Marine Mattress -- All costs for work specified in this Section and all appropriate costs in connection therewith or incidental thereto shall be included in the [applicable] contract unit price per square yard for Bid Item No. [], "Offshore Breakwater - Marine Mattress" of the Bidding Schedule.

Geotextile Underlayer -- All costs for work specified in this Section and all appropriate costs in connection therewith or incidental thereto shall be included in the [applicable] contract unit price per square yard for Bid Item No. [], "Offshore Breakwater - Geotextile Underlayer" of the Bidding Schedule.

PART 2 PRODUCTS

2.1 MANUFACTURERS

An approved source of geogrid is Tensar Earth Technologies, Inc., or approved equivalent.

2.2 MATERIALS

2.2.1 Structural Geogrid

a. Unless otherwise specified on the contract drawings, shop drawings, or directed by the Contracting Officer, the structural geogrid type shall be:

- (1) Type 1 for the internal diaphragms of the units.
- (2) Type 2 for the top, bottom and sides of the units.

b. The structural geogrid shall be produced from virgin resin and classified as HDPE and shall possess complete continuity of all properties throughout its structure.

c. The structural geogrid shall accept applied force in use by positive mechanical interlock (i.e., direct mechanical keying) with:

- (1) Compacted soil or construction fill materials;
- (2) Contiguous sections of itself when overlapped and embedded in compacted soil or construction fill materials; and,
- (3) Rigid mechanical connection elements such as bodkins, pins or hooks.

d. The structural geogrid shall have the following characteristics:

PROPERTY	UNITS	TYPE 1	TYPE 2
True 1 percent Tensile Modulus in Use (MD)	kN/m (lb/ft)	750 (51,400)	1,650 (113,090)

Junction Strength (MD)	kN/m (lb/ft)	48.60 (3,330)	100.8 (6,908)
Flexural Stiffness	mg-cm	670,000	6,600,000
Resistance to Installation Damage	percent GP	85	85
Resistance to Long Term Degradation	percent	100	100
Ultraviolet Stability (Retained Strength @ 500 hours)	percent	100	100

2.2.2 Mechanical Connection Elements

a. The mechanical connection elements shall be as shown on the contract drawings and shop drawings and shall be composed of high density HDPE, unless otherwise approved by the Contracting Officer.

b. The mechanical connection used shall be bodkin type, unless otherwise approved by the Contracting Officer.

2.2.3 UV Stabilized Braid

a. The braid used for tying and lacing in the fabrication of the units shall be 8-strand hollow-core braid composed of HDPE. Each strand shall consist of a bundle of monofilament HDPE.

b. The braid shall have a nominal diameter of not less than 3/16 inch and a breaking strength of not less than 400 pounds on a test specimen 36 inches in length.

c. The braid shall be UV stabilized with a minimum carbon black content of 2.0 percent by weight.

2.2.4 Stone Fill Materials

a. The stone fill shall be sound and durable, free of cracks, soft seams, and other structural defects.

b. Unless otherwise shown on the contract drawings and shop drawings or approved by the Contracting Officer:

(1) The stone fill shall possess a specific gravity of at least 2.16.

(2) The loss when the stone is subjected to the Los Angeles Abrasion Test shall not exceed 40 percent.

(3) The minimum diameter of stone used shall be inches across the smallest dimension of the stone. The maximum diameter of stone used shall be 8 inches.

c. Contingent on approval of the Contracting Officer, recycles, processed concrete meeting these requirements may be used as stone fill.

2.2.5 Biaxial Grid Composite

The grid composite shall be a regular grid structure formed by biaxially drawing a continuous sheet of select polypropylene material which is heat bonded to a polyester fabric, and shall have aperture geometry and rib and junction cross-sections sufficient to permit significant mechanical interlock with the material being reinforced. The geogrid shall have high flexural rigidity and high tensile modulus in relation to the material being reinforced and shall also have high continuity of tensile strength through all ribs and junctions of the grid structure. The geogrid shall maintain its reinforcement and interlock capabilities under repeated dynamic loads while in service and shall also be resistant to ultraviolet degradation, to damage under normal construction practices and to all forms of biological or chemical degradation normally encountered in the material being reinforced. The geogrid shall also conform in all respects to the property requirements listed below:

PROPERTY	TEST METHOD	UNITS	VALUE
Interlock:			
* aperture size (1)	I.D. Calipered (2)		
@ MD		in	1.8 (nom)
@ CMD		in	2.5 (nom)
* open area	COE Method (3)	percent	75 (min)
* thickness	ASTM D 1777		
@ ribs		in	0.07 (nom)
@ junctions		in	0.20 (nom)
Reinforcement:			
* flexural rigidity	ASTM D 13884	mg-cm	
MD			600,000 (min)
CMD			800,000 (min)
* tensile modulus	GRI GG1-875	lb/ft	
MD			20,000 (min)
CMD			21,000 (min)
* junction strength	GRI GG2-876	lb/ft	
MD			1,350 (min)
CMD			1,350 (min)
* junction efficiency	GRI GG2-876	percent	90 (min)
Material:			
* copolymer	ASTM D 4101		
polypropylene	Group 2/Class 1/ Grade 1	percent	97 (min)
* colorant and UV inhibitor	ASTM D 4218	percent	2.0 (min)
Geotextile:			
* Grab tensile strength	ASTM D 1682	lbs	285/250

* EOS	ASTM D 422	US Std Sv Sz	70
* Weight	ASTM D 1910	oz/sy	8.0

Dimensions:

* roll length	ft	200
* roll width	ft	13
* roll weight	lb	210 & 260

NOTES:

1. MD dimension is along roll length. CMD dimension is across roll width.
2. Maximum inside dimension in each principal direction measured by calipers.
3. Percent open area measured without magnification by COE method as specified in CW 02215 Civil Works Construction Guide, November 1977.
4. ASTM D 1388 modified to account for wide specimen testing as described in Tensor test method TTM-5.0 "Stiffness of Geosynthetics".
5. Secant modulus at 2 percent elongation measured by GRI GG1-87. No offset allowances are made in calculating secant modulus.
6. Geogrid junction strength and junction efficiency measured by GRI GG2-87.

PART 3 EXECUTION

3.1 EXAMINATION

The Contractor shall check the geogrid, braid and mechanical connection elements upon delivery to verify that the proper material has been received. These materials shall be inspected by the Contractor to be free of flaws or damage occurring during manufacturing, shipping, or handling.

3.2 FINAL FABRICATION AND FILLING

3.2.1 Mechanical Connections

The joints where the ends and baffles of each unit join the top or bottom of the unit shall be made with a mechanical connection between geogrid elements as shown on the contract drawings and shop drawings.

3.2.2 Seaming

Unless otherwise shown on the contract drawings and shop drawings or approved by the Contracting Officer:

- a. The joints along the sides of each unit shall be secured by seaming with braid using a lock-stitch configuration to provide complete closure of each unit.
- b. Stitches shall be spaced evenly along each seam, with a minimum of 6 stitches per foot of seam. The braid material shall be securely knotted to the geogrid material at each end of each seam and at a minimum 3-foot spacing along each seam. The ends of each piece of braid used shall be knotted to prevent raveling of the braid.
- c. The braiding shall be sufficiently tight to prevent openings greater than 1 inch along the seam, but shall not be cinched so tightly

that overlaps and binding result.

- d. Seaming to connect adjacent units is not required.

3.2.3 Filling

Unless otherwise shown on the contract drawings and shop drawings or approved by the Contracting Officer:

- a. Each unit shall be filled and the fill densified while the unit is supported in an upright position resting on its side. The filling sequence of the compartments within each unit shall be appropriate to prevent excess deformation or displacement of the interior diaphragms.

- b. Densification of the stone fill material and complete filling of each compartment shall be accomplished by rodding and/or vibration.

- c. Lifting hoops shall be formed by joining the top and bottom layers of grid from each unit by means of approved mechanical connections.

- d. When filling and fabrication of a unit are complete, the unit shall be rotated to a horizontal position resting on its bottom in order to facilitate subsequent lifting.

- e. Filling shall be accomplished in a manner that does not cause excessive damage to the geogrid, mechanical connection elements or the braid.

3.3 PREPARATION

3.3.1 Subgrade

The subgrade soil shall be prepared as indicated on the contract drawings or as directed by the Contracting Officer.

3.3.2 Geotextile Underlayer

- a. The geotextile underlayer shall be installed as indicated on the contract drawings or as directed by the Contracting Officer.

- b. The Contracting Officer may approve placing the geotextile simultaneously with the units by pre-attaching the geotextile material to each unit with provision for sufficient overlap of the geotextile.

3.4 INSTALLATION

3.4.1 Position

The units shall be placed at the proper elevation, alignment and orientation as shown on the contract drawings or as directed by the Contracting Officer.

3.4.2 Placement Procedures

- a. The procedure used in placement of the units shall be in accordance with the recommendations of the system supplier and as approved by the Contracting Officer.

b. For lifting of each unit, a spreader beam and/or spreader bars shall be used in a manner that the unit is not subjected to severe bending or distortion and that the top and bottom layers of geogrid are tensioned uniformly across their width. Units should generally be lifted from a horizontal position.

c. Personnel shall stay clear of the area beneath units and rigging during lifting. Tag lines and/or divers may be required to facilitate proper placement of the units.

3.4.3 Splicing and Anchoring

Where applicable, splicing and/or anchoring of the units shall be accomplished as shown on the contract drawings, the shop drawings, or as directed by the Contracting Officer.

3.5 REPAIR

Any units damaged during installation shall be repaired in a manner approved by the Contracting Officer or shall be replaced by the Contractor. Any such measures required shall be at no additional cost to the Government.

-- End of Section --